

A Frame-Relay Approach for a State-Wide Health Information Network

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ABSTRACT

An approach for a frame-relay implementation is described which is intended to establish connectivity between the health care providers in the state of Connecticut with a gateway to the internet. While other health care networking efforts have based the interconnectivity efforts on direct connections to the internet for each institution, our design takes a more cost effective approach by establishing a private health care network with a single entry point to the internet. This will not only provide the advantages of internet connections to all participating providers, but it will also isolate intrastate patient care traffic from the internet, reserving internet traffic for those information needs not available within the statewide network. In addition to the network solution, an extensive user support infrastructure is also presented.

INTRODUCTION

As is well documented in the literature, the need for health care providers to begin an information sharing effort is essential not only to maintain and minimize health care costs, but to improve the quality of patient care. The network described will answer this need by providing a communications infrastructure upon which powerful information sharing applications can be built.

As a central membership organization, the Connecticut Hospital Research and Education Foundation (CHREF) can provide a point of coordination to manage a cooperative effort among multiple health care facilities. We will provide centralized services in order to implement and maintain the network. These services will include, but not be limited to, education, administration, help desk, and network management. Details for these services will be addressed in the sections to follow.

EXPECTED USAGE AND BENEFITS

There are a number of benefits to health care providers which will be realized from this networking effort. The resources available on the health information network will directly benefit physicians, nurses, administrators, radiologists and researchers. These professionals will have access to a growing set of resources which will assist in patient management and care, consultations, and information sharing. This

in turn will benefit all those patients seeking health care from these providers.

SHARING OF PATIENT DATA

CHREF currently maintains a statewide patient database for all of the acute care facility discharges in the state. This data is used by our "Toward Excellence in Care" program to perform comparative patient outcome studies for our member institutions. It is also used for resource utilization studies to assist members in monitoring and reducing health care costs. Currently, data is collected via tape on a monthly basis and is processed in batch mode. Study results are printed and mailed to participating institutions. The data highway which would result from this networking proposal would serve to allow this process to migrate to an on-line service, allowing for more timely dissemination of quality indicator and utilization results.

Access to the statewide patient database would be a tremendous service to both the health care provider and the researcher. By making the patient medical history available to the provider, administrative time to gather patient history would be minimized, and the patient would have more immediate access to a better informed provider. The ability to electronically transfer patient information while the patient is enroute has a wealth of potential for savings in both administrative costs and expensive duplication of testing. In terms of improved patient care, the health care provider would be better served if such data could be examined before the patient arrival. As demonstrated by our "Toward Excellence in Care" program, this database is a valuable resource for epidemiological studies. By making this database available on-line to the researcher over the network, many outstanding epidemiological questions will begin to be answered.

WORLD-WIDE INFORMATION SHARING

Access to the internet will allow providers to gather and exchange information with literally a world of other health care providers and researchers. Medline is one of the most valuable resources available to the medical community today. Desk-top access to the most current medical literature would be a valuable asset to any health care facility. New databases are available every day on the internet,

which will allow providers access to the most current treatment techniques and genetic testing methods. European efforts have made available bone marrow donor databases. Similar efforts in this country would be invaluable to both the provider and the patient, and once they are available, our health care facilities will be in a position to query the data. Nutrition database efforts are underway in this country which would assist healthcare nutritionists in assessing the dietary needs of their patients. Nurses will have at their disposal a vast amount of nursing practice and educational resources as well as professional conferences and bulletin boards. Access to any available on-line federal health care regulation information would also be a valuable resource to health care administrators.

COMMUNICATIONS INFRASTRUCTURE

The network will not only address the specific areas mentioned, but will provide a basic electronic communications infrastructure for our healthcare professionals. Electronic mail and file transfer capabilities will bring our health care facilities up to speed in the electronic age reducing large volumes of paper communications, and otherwise providing for a more efficient means of communication. This basic infrastructure would make available to health care professionals access to worldwide collaborators and specialists. Medical treatment centers are notably absent from most of the hazard and disaster information computer networks. In establishing a communications infrastructure, this lack of inclusion can be addressed. Efficient communication and participation in early warning systems can minimize casualties in times of disaster.

MULTIMEDIA

This network infrastructure will also play an important role in the establishment of multimedia applications for healthcare, consultation, and administration. There are a multitude of advanced testing techniques which produce images and films for analysis. The ability to send these images over a network would allow for consultations in a timely manner, without moving the patient. This is not only a cost effective method of information sharing, it also minimizes risk to the patient. Although the development of information sharing standards are in the early stages, success in this area is imminent. Our network structure is designed to insure that this technology can be implemented with minimal effort as well as minimal additional cost with respect to the network infrastructure.

NETWORK DESIGN

Connecting each of the above facilities on an individual basis to the internet through a standard mid-level network provider would be rather expensive. Each connection requires a connection from the local site to the internet provider in addition to the provider fees. Instead, what we propose is to create a state-wide network of health care providers using a standard value added network carrier, and provide a single gateway to the internet from a central site, thus allowing the institutions to share a larger bandwidth. A T1 connection is capable of transporting 23 times as much traffic for only 2-4 times the price, and only a single installation fee is incurred. By dealing with the local carrier, additional savings are realized since the distance to the local connection is generally less. This approach is not only much more cost effective, but it also isolates from the internet intra-state health care network traffic.

Due to the voluminous nature of health care information, high band-width capacity will be necessary. It is important that the tariffs for the wide area network be offered at a fixed monthly rate rather than on a per usage basis. This will be imperative as multi-gigabyte database queries and multimedia applications become more prevalent. A poorly designed database search could itself cost on a per packet basis more than the fixed monthly fee. Based upon the status of the current technology, the best option for the wide area network will be frame relay. This will provide significant bandwidth for the participants at very reasonable monthly rates.

Frame relay technology is based upon the establishment of permanent virtual connections (PVC's) between network members. Because there has been no connectivity among independent health care institutions, the inter-institution bandwidth requirements can only be estimated. However, by providing a single 56.7 kbps connection between each participant and CHREF, all inter-institution traffic can be maintained. Subsequent analysis of traffic patterns may warrant further dedicated interconnectivity between some institutions. Based upon this approach, the central site will require high bandwidth capacity as well as a high performance router. It is anticipated that 56.7 kbps will be an underestimate based upon potential uses of the network, however, since many applications are still in the developmental stage, the higher bandwidth is not yet warranted as the cost to upgrade would roughly equivalent to three months of underutilization waste.

In order to maximize the ability to maintain

service to each site, the wide area network provider will be contracted to service the network hardware. This contract stipulates that there will be a single point of contact for wide area network problems up to and including the router. This will minimize any potential problems of wide area network components falling out of the jurisdiction of a given vendor. Staff at CHREF will be the primary contact for the provider, but service can be initiated from the remote sites.

Some of the larger facilities have plans to extend networking services to their affiliated laboratories, clinics, and other healthcare institutions not represented in this proposal. These sites will obtain additional bandwidth in order to further facilitate the statewide healthcare networking effort.

These larger sites will be equipped with T1 access to the network. The remaining institutions will begin with a 56.7 kbps access to the network with a single PVC to the central site. Because the current maximum bandwidth for frame relay is T1, the central site, CHREF, will need to support multiple high band width T1 access lines to the frame relay network. Because traffic which needs to access the internet is anticipated to be less than the intra-state traffic, and due to bandwidth limitations of the internet provider, a single T1 access line to the internet will be provided from the central site.

IMPLEMENTATION

The network implementation is a 4-phase process. Phase I of the implementation will involve networking those sites with representation on the network advisory committee. We will refer to this phase as a prototype. Phase II will involve adding those sites that have a skilled network team. The experience gathered in networking these institutions will be documented, and will be used for Phase III, which will involve networking those institutions that are network ready, but do not have an internal network management team. Phase IV will involve networking those institutions that are not yet network ready.

In order to work through the technical details of the network design, installation, and maintenance, a Network Advisory Committee has been established. This committee is a two tier group. The upper tier is composed of information system directors. This group will assist in upper level management decisions, and will serve as primary consultants for policies and procedures which may be required for network management. The lower tier of this committee is composed of network specialists. This tier will serve as technical consultants for both the

design and implementation of the network. This group will be responsible for implementing and testing the prototype.

In order to coordinate the installation and maintenance of each network site, and to maximize communication, a Network Communications Conference will be established. The conference is intended to establish a formal communication forum for network issues including implementation schedules, education, troubleshooting, and general information dissemination.

The prototype will involve connecting those sites represented on the network advisory committee. These sites are not only well supported in network communications, but they have been involved in the network design. This prototype will be used in order to work out any unanticipated connectivity problems, and as a benchmark for network utilization studies. This effort will be used as a learning process in order to gather additional experience with the set-up. The prototype experience will be documented and used as a baseline for subsequent implementation phases. Based upon the background obtained from this implementation experience, a formal implementation approach will be tabulated in order to minimize implementation problems as subsequent sites. The prototype phase will be coordinated through the Network Advisory Committee. This group will, as part of the prototype, implement an electronic conferencing method in order to maximize communication potential and to minimize travel.

Once the prototype is sufficiently tested, phase II is initiated. This will involve bringing on-line those sites with strong network support capabilities. This effort will test the deployment techniques developed during the prototype. Based upon feedback from these sites, the implementation methods will be refined so as to minimize difficulties in subsequent installations. Because the target sites for this installation phase are well supported, additional experience with the network will be obtained with minimal interruption and time expenditure. This phase will involve coordination between the central network support specialist and the network representative from the health care site. While the implementation details for each site may be somewhat different, the central network support specialist will be encouraged to visit these sites in order to maximize the experience level of this individual for subsequent installations.

Before embarking on phase III of the installation, an educational program will be sponsored at CHREF in order to provide the information system personnel with sufficient information to prepare for

both the installation and maintenance of the networking equipment. Any additional information learned during either the prototype or during phase II will be disseminated at this time as well. Should there be a need for additional educational programs for installation and maintenance, multiple programs will be provided.

Those sites that do not currently have a network in place will need additional assistance in order to establish a link to the internet. Minimally, a personal computer with a network card, TCP/IP, a hub, cables, and installation. Because these sites may wish to implement a more extensive solution, a list of systems integrators will be provided. The central network support specialist will work closely with these sites to assist in finding resources for the sites' internal network structure, however, the responsibilities of the central network support specialist will end at the router.

Because the current network design is based upon anticipated usage, a tuning effort will be necessary. The first tuning analysis will be performed on the pilot sites. Any changes in Permanent Virtual Connection designation will be applied to phase II sites. Similarly, a performance analysis will be performed prior to phase III and phase IV implementation.

LOCAL SUPPORT

User support for each local site will primarily be the responsibility of the information systems staff of each participant. Support at this level will therefore be in an indirect manner. Each site will be asked to designate an information systems representative to the Network Communications Conference. This will provide a formal vehicle for information transfer as well as a primary point of contact for maintenance and enhancement purposes. Educational programs will be offered to members of this group such that they will be better prepared to provide local network support. As appropriate, members of this conference and members of the Information Systems Conference will sponsor educational programs to end-users in conjunction with the many other conference groups of the Connecticut Hospital Association (CHA).

CENTRAL HELP DESK SUPPORT

In addition to the user support for each local site, there will be central support services provided. These services will include a help desk coordinator. This individual will be available for telephone support and basic troubleshooting. This individual will assist in identifying the source of a given problem, and will

be apprised of the appropriate measures to be taken to address the problems. The central network specialist will provide technical support to the help desk, but the help desk coordinator will serve as the primary liaison. In addition to troubleshooting support, the help desk coordinator will be responsible for identifying and researching value added services on the internet which might benefit health care institutions. Those functions which require systems integration will be referred to the network specialist and the project coordinator for further investigation. For those services which require no further integration, the help desk coordinator will investigate the features and user procedures, document instructions for use, and disseminate the instructions to the remote site contact. Those services with sufficient merit will be referred to the Information Systems Conference for an educational seminar. A newsletter targeting the end-user will be established and disseminated to the user community.

ELECTRONIC HELP DESK

In order to better service the network user community, an electronic help desk will also be established. This electronic help desk will be based upon an e-mail function. While central network support personnel will primarily be responsible for responding to items listed in the electronic help desk, this forum will be supplemented by the technical members of the Network Advisory Committee.

EDUCATIONAL SERVICES

As mentioned above, educational services will be provided to both user groups and user support personnel. These services will include investigation into value added services and databases on the internet relevant to health care and health care administration. Newsletters, instructions and bulletins will be used as a conveyance vehicle to inform the user community of available features. Seminars and training sessions will be offered centrally.

COOPERATION AND COMMUNICATION

Because of the nature of the membership organization, CHREF as an affiliate of CHA, has at its disposal a means of establishing and maintaining communication and cooperation among member health care organizations. This is an essential component of any effort which intends to collect and distribute information from among multiple independent parties. CHA has in place several conferences of health care professionals which generally meet on a monthly basis. This is a natural vehicle to establish consensus, standards, and

information exchange. It also provides a means of educating members in the midst of change. By tapping into these conferences, members of the Information Systems Conference hope to identify the information system needs of each group, and use the conference structure to provide appropriate educational services to each group.

Information systems professionals from acute care hospitals have also begun to take on a role in establishing and providing information services to affiliated physician offices, laboratories and pharmacies. By establishing consensus and cooperative design efforts within this group, CHREF can be assured that changes and migration are uniform within the state, and thereby minimize the duplication of effort.

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